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# EXPERIENCE IN RETRAINING
# 'N THE DVORAK KEYBOARD

BY

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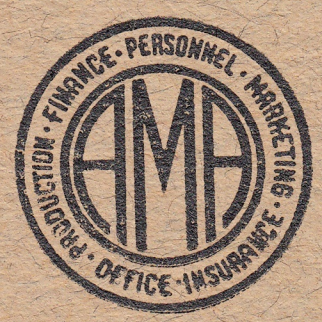


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# INTRODUCTION

WHEN Dr. August Dvorak of the University of Washington and his associates were seeking a method to reduce the learning time required for skilful typewriter operation, they concluded that the Universal (standard) Keyboard was not perfect. With the intention of remedying its defects, Dr. Dvorak developed a new keyboard, having an entirely different placement of letters.

The Dvorak Keyboard is designed to eliminate "one-hand words" and equalize the work load on the different fingers. On the Universal Keyboard, 57 per cent of the work is done by the left, or weaker hand; on the Dvorak Keyboard, 56 per cent is done by the right, or stronger, hand. On the new keyboard, 70 per cent of the keystrokes are made on the home, or middle, row, eliminating many unnecessary finger reaches. The index fingers are relieved of the burden of the work under the Dvorak system, and the letters are rearranged so that fingers work more equally.

It has been variously claimed that the Dvorak Keyboard is faster, more accurate, less fatiguing, and easier to master than the Universal Keyboard. To discover whether experienced operators could profitably be retrained to use the new keyboard, the Office Management Division of the American Management Association undertook a retraining program for Universal Keyboard operators in the Chicago area. Six companies participated in the program. In the report that follows, Mr. C. L. Stivers, who directed the project, describes retraining methods and results, and tells the conclusions reached at the end of the study.

# EXPERIENCE IN RETRAINING ON THE DVORAK KEYBOARD

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WHEN business men hear favorable reports on the new Dvorak system of typing, immediately they wonder: Does it pay to retrain Universal (standard) Keyboard typewriter operators to use the Dvorak Keyboard? Before attempting to answer this question, a review of the history of the Dvorak Keyboard might be timely.

The amount of time and effort required to teach and to obtain even a low degree of skill in operating a typewriter has bothered teachers for many years. Dr. August Dvorak of the University of Washington and his associates found at least a partial explanation for this when they studied the Universal Keyboard, standard on all typewriters, which, incidentally, has been but slightly changed since it was originally designed some 60 years ago.

Their investigation showed that the standard keyboard is "haphazard, unbalanced, and awkward in that:

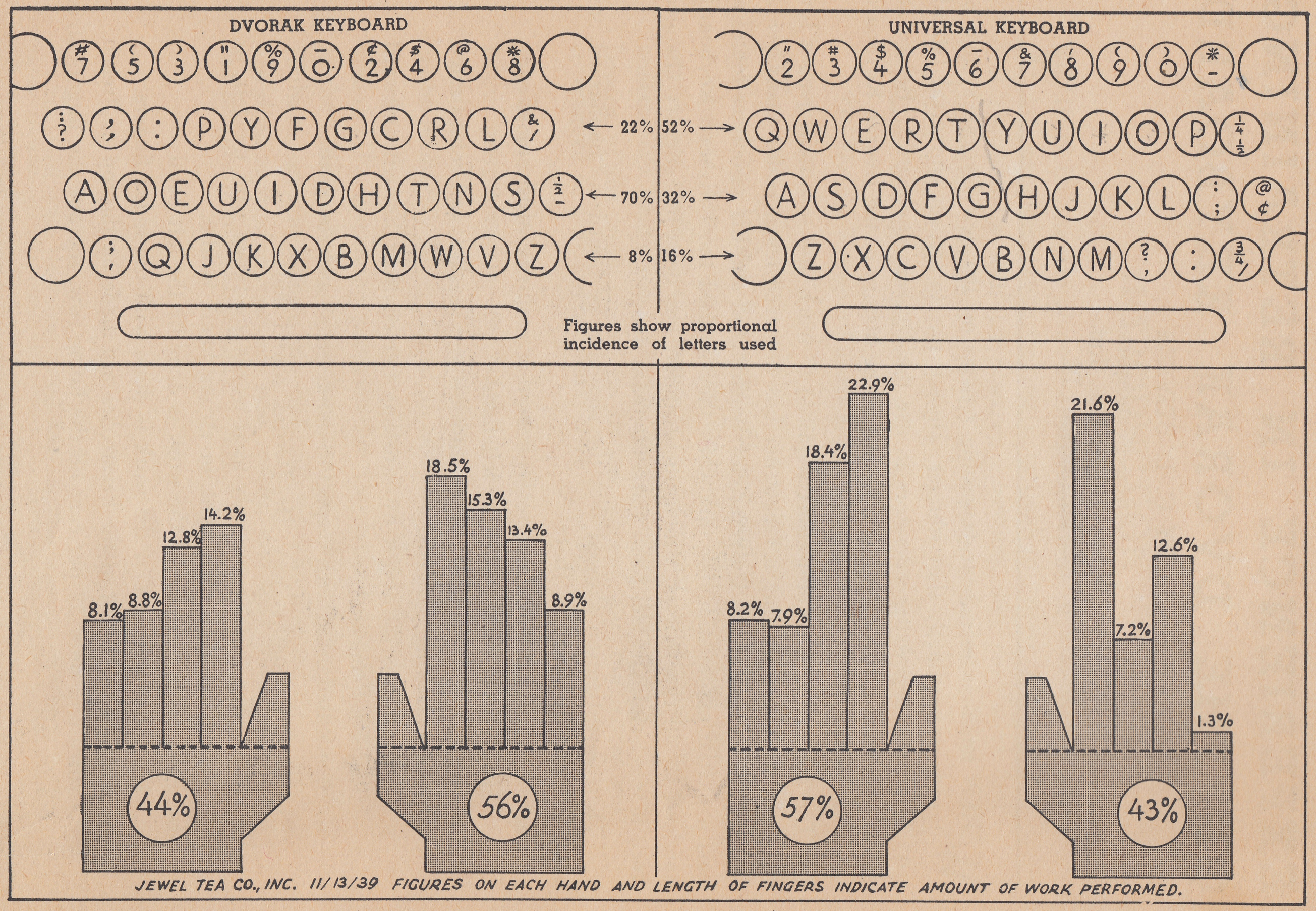
a. It compels the operator to type a great majority of the most commonly used words with the left hand.
b. It requires unnecessary finger hurdles and reaches, and complicated finger-stroking patterns.
c. It handicaps the typist by breaking her rhythm through awkward finger sequences.
d. It is unbalanced with respect to hand, finger and row loads."*

Expressed in another way, Dr. Dvorak found that:

a. More than 2,700 commonly used words are typed with the left, or weak hand, while the right, or strong hand, is idle.
b. Fifty-seven per cent of the work is done by the left hand.
c. Forty-five per cent of the work is done with the index fingers.
d. Fifty-two per cent of the keystrokes are made on the top or "reach row" and only 32 per cent on the home row, the one the fingers strike naturally.

* "The Findings of the Carnegie Typewriting Investigation," American Book Company.

# EXHIBIT I


DVORAK KEYBOARD
UNIVERSAL KEYBOARD
22%
52%
70%
32%
8%
16%
Figures show proportional incidence of letters used
8.1%
8.8%
12.8%
14.2%
44%
18.5%
15.3%
13.4%
8.9%
56%
8.2%
7.9%
18.4%
22.9%
57%
21.6%
7.2%
12.6%
1.3%
43%
JEWEL TEA CO., INC. 11/13/39 FIGURES ON EACH HAND AND LENGTH OF FINGERS INDICATE AMOUNT OF WORK PERFORMED.

As a result of this study, the present Dvorak Keyboard was designed. (See Exhibit I.) Experimental and practical studies show that:

a. Only 69 words are typed with the left hand and none with the right hand, while the other hand is idle.
b. Only 44 per cent of the work is done with the left hand (better hand load).
c. Only 33 per cent of the work is done by the index fingers (better finger load).
d. Only 22 per cent of the keystrokes are made on the top or "reach row," *70 per cent* being made on the home or middle row (better row load).

These studies have proved the claim that the Dvorak Keyboard is faster, more accurate, less fatiguing, and easier to master than the Universal. Experiments have shown that children are able to learn typing twice as fast on the new keyboard and that only one-half as many errors are made. In a seven-hour day at 70 words a minute, the finger paths traveled vertically and horizontally total 1 mile on the Dvorak, as compared with 7 to 10 miles on the Universal.

## WHY IS IT NOT IN MORE GENERAL USE?

Naturally, the question arises, "If this keyboard does all that is claimed for it, why is it not in more general use?" The answer is simple.

a. Schools do not teach it because the places where their graduates must look for employment do not have the machines.
b. These business houses do not have the machines because no one knows how to operate them.
c. Typewriter manufacturers do not equip their machines with the Dvorak Keyboard because schools do not teach how to use them and no one will buy them.

There exists, then, a three-rung hurdle which no one to date has been able to eliminate. One way to solve the problem would be to start with experienced operators, rather than beginners. If these persons could be profitably retrained, industry could gradually adopt the new keyboard. Then schools could teach its use, manufacturers would gladly equip their machines with it, and the much-needed transition could be painlessly made. The question, "Does it pay to *retrain experienced Universal Keyboard operators* to use the Dvorak Keyboard?" therefore arises.

## AMA RESEARCH PROJECT

In order to find the answer to this question, the Office Management Division of the American Management Association carried out a retraining program in the Chicago area. Those who participated in the project were considerably encouraged by the fact that an operator in the office of one of the participating

companies who had been retrained earlier in the year on the Dvorak Keyboard was making satisfactory progress, and that there would be available the knowledge, advice, and help of Miss Nellie Merrick of Chicago University High School, who collaborated with Dr. Dvorak in his original study and who has since taught typing on the new keyboard to thousands of students.

The following six companies agreed to cooperate: Commonwealth Edison Company, Continental Illinois National Bank and Trust Company of Chicago, Kraft Cheese Company, Montgomery Ward & Company, Sears, Roebuck and Company, and Jewel Tea Company, Inc. The American Book Company also sent a representative, but since they do not measure their production, their participation was merely one of interest in the project.

Girls were selected for retraining:

(a) Whose output had for some time been regularly measured in lines, square inches, or keystrokes.

(b) Who had leveled off in production to the extent that their output had not varied more than 5 per cent during the previous six months.

(c) Who would approach the project with an open mind, being interested only in fact-finding and not in proving that the keyboard was practical or impractical.

(d) Who would be provided with machines similar to those used prior to retraining, i.e., the same make with the same carriage length and other devices typists use—such as decimal tabulators, etc. The use of better mechanical devices on training machines than the trainee was accustomed to was carefully guarded against, in order to eliminate from consideration any increases in speed which might possibly be attributed to this factor.

## The School

Bryant and Stratton Business College which is centrally located in downtown Chicago volunteered a room for class instruction and a part-time teacher.

## The Classes

| | |
|---|---|
| First two weeks: Five days a week - - - - - | 30 hours |
| Trainees met as a class under Miss Merrick's instruction from 8:30 to 10:00 a.m. and from 3:30 to 5:00 p.m.* During these two weeks the trainees did no typing at their offices. | |
| Next eight weeks: Five days a week - - - - - | 60 hours |
| Trainees assembled for instruction from 3:30 to 5.00 p.m. When not in class, they worked at their offices on their regular tasks on typewriters equipped with Dvorak Keyboards. | |
| Total class instruction - - | 90 hours |

* After the first day, morning classes were conducted by Miss Edna Bills, a member of the Bryant and Stratton faculty.

### Progress Reports

Each company reported the progress of its representative, beginning with the first week's actual work (the third week of training). The progress figures were tabulated as shown on Exhibit II and the comparative figures were reported to the cooperating companies. Reports were supplied by them until the girls had leveled off in production, indicating that they had reached the maximum that might be expected.

## WHAT DID THE STUDY SHOW?

### Advantages of Retraining

As would be expected, the study brought out both the advantages and disadvantages of retraining. There are several outstanding advantages. First, the retrainees are enthusiastic about the new keyboard after they learn how to use it. Second, an increase in production will follow. Third, less equipment will be needed. Fourth, operators will probably make fewer typographical errors.

#### TRAINEES LIKE THE NEW KEYBOARD

All trainees like the Dvorak Keyboard. However, for the first few days, the change is quite a strain on them. Fingers that have been trained to react immediately in a certain manner to given mental impulses are asked to react in a different manner. That which was a highly-skilled motion unconsciously done now becomes a very clumsy operation consciously done. For this reason, the trainees did no work on the typewriter for the first two weeks of retraining except the practice work done in class. It was believed that immediate full-time work on the new keyboard might result in more nervous tension than the trainees should be asked to undergo.

It was not long, however, before the new keyboard began to "take." After the first few days the attitude of the trainees changed from grim determination to a feeling of surprise that the task was going along so easily, and then, to pleasure in the ease of operation of the keyboard. All retrainees are surprisingly enthusiastic about the keyboard and say that if given their choice of machines and time to change back to the standard, they would still much prefer the new one. All seem to feel that they are much less fatigued at the end of the day's work than they formerly were.

One retrainee who married and left the service of one of the cooperating companies asked and received permission to buy her machine so that she could take it with her, so well pleased was she with it.

#### OUTPUT INCREASED

Four of the six girls had surpassed their average output during the 12 weeks prior to retraining, by the time the program was concluded. (See Ex-

# EXHIBIT II

## PRODUCTION PROGRESS REPORT
## DVORAK TYPEWRITER KEYBOARD RETRAINEES

| | No. 1 | No. 2 | No. 3 | No. 4 | No. 5 | No. 6 |
|---|---|---|---|---|---|---|
| Average keystroke per minute 12 weeks prior to retraining | 110 | 162 | 126 | 158 | 184 | 158* |
| Retraining Weeks | Percentage of Former Production During Retraining Period | | | | | |
| 3d | 61% | 54% | 55% | 51% | 50% | 59% |
| 4th | 83 | 64 | 58 | 59 | 52 | 70 |
| 5th | 76 | 70 | 60 | 62 | 57 | |
| 6th | 85 | 73 | 63 | 66 | 61 | 87 |
| 7th | | 71 | 68 | 77 | 70 | |
| 8th | | 87 | 63 | 78 | 77 | 91 |
| 9th | | 88 | 70 | 73 | 75 | |
| 10th | | 95 | 70 | 80 | 85 | 93 |
| 11th | | 95 | 67 | 84 | 80 | |
| 12th | 95 | 78 | 74 | 80 | | 95 |
| 13th | | 89 | 80 | 80 | 61 | |
| 14th | | 96 | 81 | 85 | 89 | 100 |
| 15th | | 85 | 75 | 77 | 87 | |
| 16th | 95 | 97 | 79 | 78 | 89 | 97 |
| 17th | | 102 | 79 | | 90 | |
| 18th | | 92 | 84 | | 91 | 105 |
| 19th | | 94 | 73 | | 90 | |
| 20th | 105 | 89 | 83 | 79 | 90 | 109 |
| 21st | | | 88 | | 97 | |
| 22d | | | 87 | | 95 | |
| 23d | | | 93 | | 97 | |
| 24th | 106 | 96 | 95 | | | |
| 25th | | 103 | 94 | 90 | 93 | |
| 26th | | 97 | 93 | | 92 | 107 |
| 27th | | 101 | 92 | | 98 | |
| 28th | 111 | 90 | 98 | | 90 | 111 |
| 29th | | 96 | 106 | 95 | 90 | |
| 30th | | 103 | 105 | | 92 | 108 |
| 31st | | 97 | 111 | | 93 | |
| 32d | 102 | 103 | 110 | | 89 | 106 |
| 33d | | 102 | 104 | 92 | 94 | |
| 34th | | 92 | 102 | | 90 | |
| 35th | | 85 | 105 | | 86 | |
| 36th | 108 | 97 | 104 | | 95 | 107 |
| 37th | | 96 | | | 93 | |
| 38th | | 110 | | | 92 | 108 |
| 39th | | | | | 87 | 109 |
| 40th | 104 | | | | 93 | |
| 41st | | 107 | 112 | | 90 | |
| 42d | | | 102 | 87 | 82 | |
| 43d | | | 105 | | | 108 |
| 44th | | | 111 | | | |
| 45th | | | 124 | | | |
| 46th | | | 121 | | | |

* The production of Retrainee No. 6 was measured in lines per hour.

hibit II.) Operator No. 4 would have progressed more rapidly, had not her work been interrupted by illness and a long vacation. While an increase in output unquestionably will result, it is difficult to determine from such a small sampling how much might be expected. It is believed, however, that a 5 per cent increase is a very conservative estimate. This "additional output" will continue year after year, as long as the operator continues in the work. As each year passes, the benefits derived from retraining will accumulate.

It is believed that most of the increased output is the result of the improved layout of the Dvorak Keyboard. No doubt some of it comes from the fact that the keyboard is new, and that the operators try harder just because it is new and novel. Even if this is true, the additional work put out is still the result of the change to the new keyboard.

### LESS EQUIPMENT NEEDED

The higher the production of the operators, the fewer are needed. A smaller number of operators takes less equipment—fewer typewriters, desks, and chairs. This would be a sizable saving, particularly in large offices.

### EFFECT ON ERRORS

No record was kept of errors made prior and subsequent to retraining. The participating companies, therefore, could not state authentically that the typists were more accurate after retraining. On the other hand, no increase in errors was noticeable. It seems logical to assume that typographical errors would increase during retraining. It is equally logical to assume that since the keyboard is easier to operate, and since awkward finger sequences and stroking patterns are eliminated, operators are likely to be more accurate and neat in their work than they were on the standard keyboard.

## Disadvantages of Retraining

The results of retraining are not all on the positive side. There are also some distinct disadvantages—namely, loss in production while retraining, less flexibility, and employee opposition.

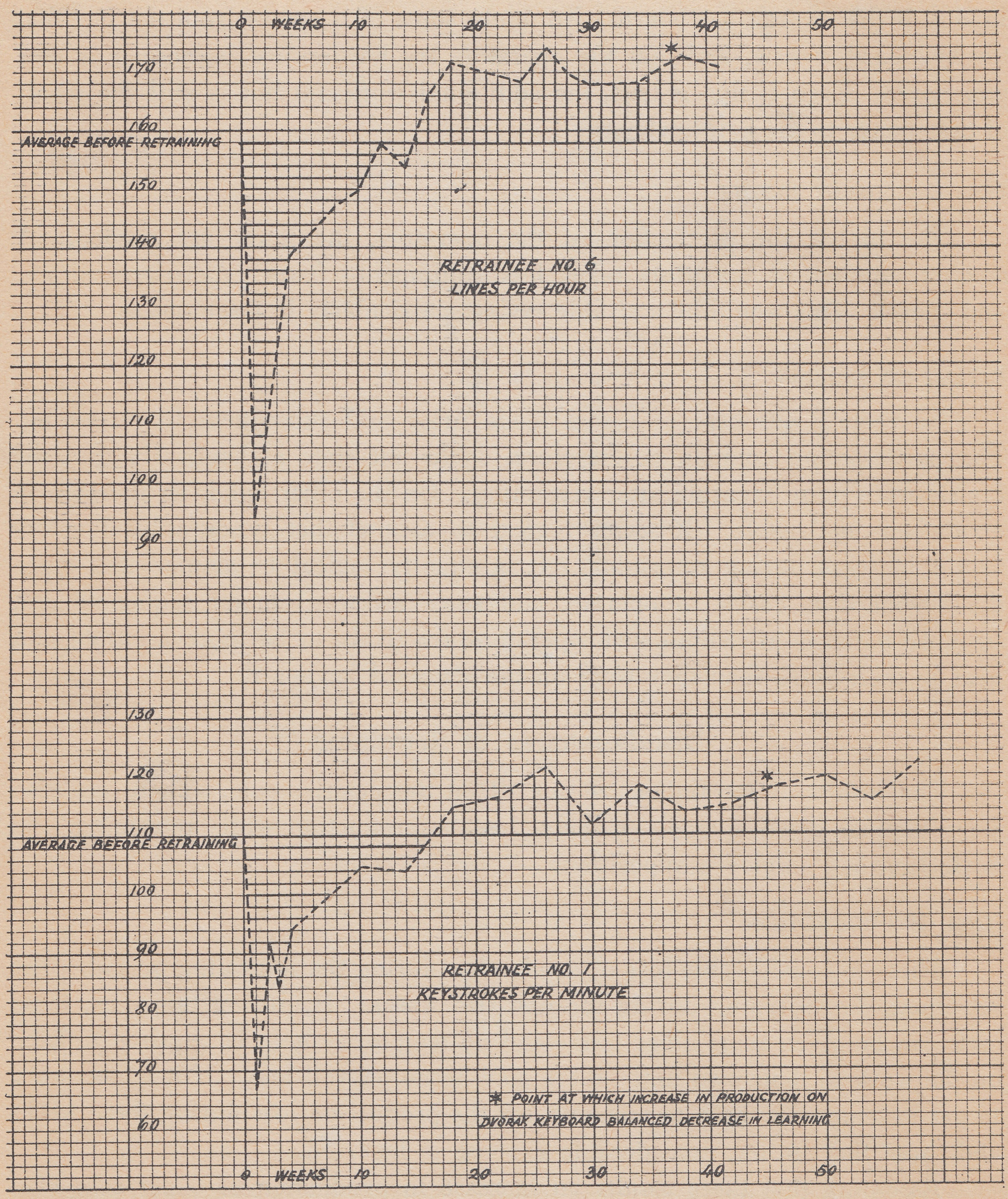
### LOSS OF PRODUCTION

There is considerable loss of production during the retraining period. The retrainees do no typing during the first two weeks. If, during this time, these girls can be given some other task—and no temporary help is required to keep up the work in their own unit—there may be no payroll loss. If it is necessary to get in temporary help to make up for the production loss during these weeks and those that follow, considerable expense is incurred.

Assuming that there results an increase in production of 5 per cent over pretraining output and considering the first two weeks as a total loss, it would

take from 15 to 20 months to offset the total retraining expense. In many instances, the retrainee would be out of service before any material benefits would be obtained.

## EXHIBIT III



If the first two weeks of training do not result in a payroll loss, the time required to make up the retraining loss cannot be considered prohibitive. It is estimated that the increase in production of Operator No. 6 balanced the loss as a result of retraining (not counting that of the first two weeks) at the end of 37 weeks, and Operator No. 1 at the end of 45 weeks. This is graphically shown in Exhibit III. The others had not balanced their loss at the time the study was discontinued.

### LESS FLEXIBILITY

With two keyboard arrangements it would be more difficult to switch machines among the typists. The plan of placing the older machines where they would be used less and where a lower standard of work from an appearance standpoint is acceptable would be less practical.

### OPPOSITION TO RETRAINING

There would be considerable opposition to retraining. One of the idiosyncrasies of human nature is the aversion to change. This aversion would not be wholly illogical because it would be more difficult for the retrainees to get positions elsewhere should change be desired or forced upon them. A difficult management problem would therefore be created.

### BONUS PLAN

A management problem would also present itself where bonus plans are in effect. It is doubtful whether companies would care to go to the trouble and expense of retraining its operators and also give them all of the financial benefit that would be theirs as a result of increased output. To avoid this, bonus plans would have to be changed, a matter which involves no little study and inconvenience.

## CONCLUSION

1. Those retrained on the Dvorak Keyboard are enthusiastic about it and would not like to return to the Universal. All found it less fatiguing. It can be assumed, therefore, that could retraining be made general, so that operators would not be handicapped when changing positions, the change would, on the whole, be welcomed by the operators.
2. An increase in output will follow. It is not believed, however, that sufficient increase can be expected to provide the incentive that will stir business men to make the effort to retrain operators and to accept the inconveniences that accompany the project. All cooperating companies agree that the experiment was worth while, but that for the time being at least they are not sufficiently enthusiastic about the results to wish to retrain other operators.

3. From a purely humanitarian viewpoint, the reduction in operator fatigue may eventually prove sufficient cause to bring about the general adoption of the Dvorak Keyboard and the retraining of operators. The current trend in all phases of life, in business as well as in the home, is to lighten the load, to accomplish more with less effort. The Dvorak Keyboard is such a device, but it is doubtful that this advantage will aid enough to bring about its early adoption through retraining.
4. The Dvorak Keyboard has all the advantages claimed for it. However, at least for the *present, retraining* is not the answer. It was the consensus of participating companies that the initiative in making the change, if it is to be made, must be taken by the high schools and business schools. It was generally agreed by these companies, however, that should the schools take this responsibility and train beginners on the Dvorak Keyboard, they would gladly employ those who otherwise meet their requirements, even though this would mean considerable inconvenience because of the inflexibility feature.

The three-rung hurdle, therefore, has not been removed. The change at first consequently will be very slow. More and more, however, beginners are learning to type on typewriters equipped with this keyboard. Gradually, it is being adopted by persons who wish to know how to type as a means of written expression and by high schools and business colleges. While the spread seems slow, it is believed to be steady. At present, it is a very small snowball, but it is rolling down hill, gathering momentum and substance as it goes. Somewhere in the future, and perhaps not as far distant as we may think, lies the point at which it will be necessary for industry to purchase Dvorak-equipped typewriters for operators newly employed. When that time arrives, inflexibility may make a rapid change-over advisable, and retraining may then blossom forth and be the saving grace during this period of transition.